(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 283 137 A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 88301400.3

(22) Date of filing: 19.02.88

(51) Int. Cl.⁴: B44D 3/00 . B44D 3/08 . B65B 3/12

(30) Priority: 09.03.87 GB 8705482

(43) Date of publication of application: 21.09.88 Bulletin 88/38

(84) Designated Contracting States: AT BE CH DE ES FR GB IT LI NL SE

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(54) Automatic dispensing system for liquids.

(57) A liquid dispensing system for example for paints comprises a liquid reservoir (3), a circulating path (1) for the liquid to and from the reservoir, a pump (2) for causing a pressurised flow around the path (1), a three-way valve (4) in the path which is controllable to divert liquid from the path (1) via a second valve (6) to a dispensing nozzle (14). The second valve (6) is biased to a closed position and is openable by the hydraulic pressure of the diverted liquid to permit the diverted liquid to flow to the nozzle (14). In a multiple liquid dispensing system, e.g. a paint blending system, each liquid has its own dispensing system as described above and the plurality of second valves (6) thus provided are disposed in a conical formation with the nozzles directed towards the apex of the cone.

Fig.1.

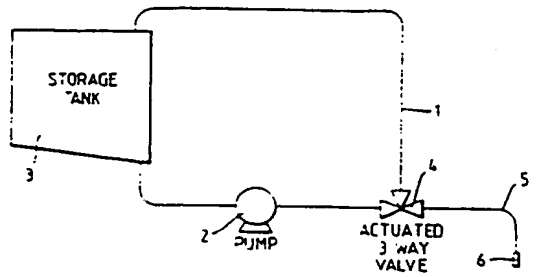
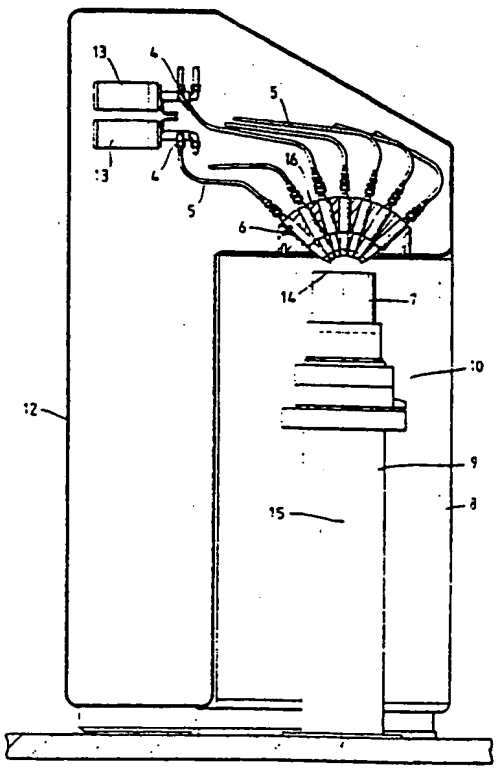


Fig.2.



EP 0 283 137 A1

Automatic Dispensing Systems for Liquids

This invention relates to dispensing systems for liquids and for suspensions, such as paints, having liquid carriers. Such liquids and suspensions will hereafter be referred to collectively as liquids.

The paint manufacturer is faced with the perennial problem of supplying to his customers many different coloured paints and usually more colours than the manufacturer can as a practical matter keep in stock. The problem is especially acute in the supply of paint for vehicle refinishing, that is to say in the supply of paint for respraying vehicles, for example, a crash repair. The difficulty is that vehicle manufacturers supply their vehicles in many different colours and in subtly different shades. Even for a given make, model and colour slight variants can arise between the exact colours of particular cars because of variants in the batches of paint used in manufacture. Moreover, commercial transport operators often wish to respray their vehicles in their own distinctive liveries. As a result, the number of paint colours in use is extensive and may be as high as 30.000.

Paint manufacturers succeed in providing the large number of colours called for by a method of blending. A number of basic or standard colours are produced that usually contain a single pigment but may contain a major proportion of one pigment and a minor amount of another sufficient to produce the standard colour. A typical standard range will contain from 20 to 50 basic colours which can be blended to give thousands of other colours. Thus, the refinisher or refinish paint supplier is in the position that he needs to stock between 20 to 50 colours only depending upon the particular range of paints that he wishes to supply.

In order to match the cars he repairs, he must mix these paints very carefully and very accurately against a formula or mixing scheme which is supplied by the paint manufacturer. The mixing scheme will set out the proportions of basic colours which have to be mixed to match the exact colour of the particular make, model and colour variant of the repaired car.

It is important that the basic colours are supplied and maintained in a very consistent condition. It is also important that they be dispensed very accurately indeed, against a formulation which is accurate to start with.

In providing an ideal dispensing system for use in paint blending there are certain desirable objectives, namely

(1) accurate blending

(2) efficient operation without maintenance problems.

(3) automatic operation

(4) low cost

In automatic dispensing systems there is usually a requirement to have some form of recirculation of the paint to prevent settling of the pigment.

There are several disadvantages in the systems on sale today, one of which is the large size of valves used and from which the paint is required to be dispensed into say either a 2½ litre container or a 1 tonne container as selected. The consequence of having a number of bulky valves is that it is impossible to position all of them above a container of any practical size. Thus one has an immediate problem of directing the paint to be dispensed into the container. There are two obvious solutions. One is to move the container every time a dispense is required so that the centre of the container is positioned under the valve to be used for that particular dispense. This is obviously inconvenient and can be error prone. It is particularly inconvenient in the case of machines where the container may weigh one tonne or more. An alternative way is to move the valves to always position the valve which is about to dispense above the centre of the container. There are at least two known ways of doing this. In one method the machine has a huge crescent shaped carriage on which the valves are mounted and this carriage swings around in a great arc in order to position each of the valves above a container. Because the valves swing by such a large amount (several metres) the pipes leading to the valve have to be flexible. Not only that but since the length of pipe varies as the mounting plate swivels there has to be some other means of adjusting the length which in turn involves another compensating mechanism with flexible hoses. The degree of complexity that would be introduced if one had recirculation within these flexible pipes is so immense that the requirement of recirculation has to be omitted.

The object of the invention is to provide an automatic dispensing system having recirculation and whose dispensing valves are of such design that they can be made sufficiently small to be grouped together over a target container as small as 1 litre to provide the typically required number of basic colours for blending without having to move the container.

According to the present invention, a liquid dispensing system comprises a circulating path for the liquid to and from a reservoir, means for pressurising the liquid to cause it to circulate around said path, a first valve means controllable to divert the liquid from the circulating path to a dispensing nozzle and a second valve means past which the

diverted liquid flows. the second valve means being biased to a closed position and being openable by the hydraulic pressure of the liquid to permit the liquid to be passed through it to the nozzle.

In application of the invention to a paint blending system one such dispensing system will be provided for each basic colour.

The first and second valve means need not be positioned adjacent each other but could be interconnected by a liquid feed line. The second valve means can be designed as a relatively slim valve and does not have to carry bulky actuating means. Consequently a relatively large number of them can be disposed close together for feeding paint into a target container.

Advantageously, in application of the invention to a paint blending system, the bodies of the plurality of second valve means are arranged as a group to form an inverted conical shape with the nozzles directed towards the apex of the cone. Ideally the target container at a filling station is arranged so that the apex of the cone lies on its vertical axis and within the container.

The invention will now be further described by way of example as applied to a paint blending system and with reference to the accompanying drawings in which

Figure 1 shows a schematic diagram of one dispensing system in accordance with the invention

Figure 2 shows in central section the general arrangement of the dispensing machine of the system.

Figure 3 shows a longitudinal section of the dispensing valve used in the system. the valve being illustrated in its closed position.

Figure 4 is a scrap view showing the dispensing valve in its open position.

Figure 5 shows to a larger scale than Figure 2 an elevational view of a plurality of the dispensing valves grouped in conical formation above a target container, and

Figure 6 shows a plan view of the plurality of dispensing valves.

The basic dispensing system for a single colour paint is shown in Figure 1 and comprises a recirculation loop 1 around which the paint is continuously circulated under pressure by a pump 2 from and back to storage tank 3. Disposed in the loop 1 is a three-way control valve 4 which can be selectively operated to divert paint from the loop 1 into branch line 5 to dispensing valve 6 and from there into a container 7 (Figures 2 and 5).

Referring more particularly to Figure 2 the dispensing machine itself comprises an inner casing 8 within which is disposed a pedestal 9 for supporting the paint container 7 at a filling station. In an alternative embodiment, the pedestal 9 can be replaced by a transporting conveyor which periodically stops when a container is at the filling station to allow the paint to be dispensed into it. The upper end 10 of the pedestal 9 constitutes a weighing scale 10 for weighing the amounts of paint fed by the valves 6 to the container 7. An outer casing 12 surrounds the inner casing 8 and within this are disposed a series of the three-way valves 4 corresponding in number to the maximum number of basic colours to be dispensed by the machine. Each of the valves 4 has a respective pneumatic actuator 13. A respective branch line 5 leads from each valve 4 to a respective dispensing valve 6.

Each of the valves 6 is of a slim elongated tubular design with a nozzle 14 at its lower end through which the paint is ejected into the container 7. From an inspection of Figures 2, 5 and 6 it can be seen that the valves 6 are arranged in an inverted conical formation with the nozzles 14 directed towards the apex of the cone, which lies within the container 7 and on the central vertical axis 15 thereof. In this particular example there is a group of thirty-seven dispensing valves 6. To provide the conical arrangement of the valves 6, they are mounted in respective bores of a common mounting block 16 which is supported on the top of inner casing 8. In Figures 5 and 6 are shown the position which two different sized containers referenced 7a and 7b would have relative to the nozzles 14.

The construction of the dispensing valves is best seen in Figures 3 and 4. A valve stem 18 is slidable in an outer elongated tubular valve body 19 and is biased by spring 20 to a closed position in which the conical valve member 22 at the lower end of the stem 18 is urged into engagement with conical seat 23 at the nozzle 14 to close off outlet nozzle orifice 24. The valve stem 18 has a central bore 25 which terminates at its lower end in transverse bores 26 and 27. The upper end of the bore 25 provides a liquid inlet to the valve 6 and connects with one of the feed lines 5. Thus when the associated three-way valve 4 is operated paint flows along the feed line 5, through the bore 25 and out of the transverse bores 26 and 27 into the annular space 28 within the interior of the body 19 between the valve stem 18 and the lower part of the body 19.

The valve stem 18 is provided intermediate its ends with a piston formation 29 which is a close sliding fit in the upper part of the body 19. The periphery of the piston 29 has two 'O' rings which provide liquid-tight seals preventing paint escaping upwardly past the piston 29. When the associated control valve 4 is operated the flow of pressurised paint first fills the annular space 28 and then acts on the lower face of the piston 29 to cause it to move upwardly against the spring bias and thus corresponding upward movement of the valve stem

18 to cause the valve member 22 to move away from the valve seat 23 to fully open the valve to the position shown in Figure 4 so that the paint passes through the orifice 24 into the container 7. As soon as the pressurised paint supply to the valve 6 is stopped by operation of the valve 4 to close off the feed line 5, the valve 6 is instantaneously closed under spring pressure.

Advantageously the weighing scale can be interfaced with a computer which controls the actuation of the pneumatic valves 13 to close off the paint supply to the container when the predetermined weight of paint has been delivered. In this way various refinements can be incorporated into the dispensing system by writing them into the computer software.

Although in the particular example there are 37 dispensing valves, this number is to some extent arbitrary but arises from the geometric pattern shown in the plan view of Figure 6 where one valve is at the centre, six in the next ring twelve in the next ring, eighteen in the next ring and so on. It is not necessary to have each valve the same size though this is naturally convenient. It could be that one or two or more valves are of a larger size for a particular application. For example, the centre valve may be very much larger than the others and used to supply the white paint which is normally required in larger quantities.

The valves 6 are as previously stated mounted in a machined block 16. The advantage of the particular construction and arrangement of the dispensing valves as described is that they can be made by automatic machining processes and are therefore low cost items which are simply popped into the mounting block and secured with a clip. This is a very important feature in use, since any maintenance problems can be very quickly dealt with by changing a valve rather than repairing it.

A lot of valves on the market for use in paint blenders appear to have been influenced by the design of automotive poppet valves as used in most motor cars. In this type of valve the valve stem or the male member moves away from the end of the valve body outside the valve body in order to open. This is an advantage in automobile engine design since the shape of the valve when open helps to spread the gas and the fuel charge around the cylinder. When this type of valve is used for dispensing paint it has a definite disadvantage, since the paint is directed into a divergent flow pattern which can cause excessive splashing. Equally if the valve does not open absolutely concentrically then one can get a jet of paint emerging preferentially from one side of the valve. This is not a trivial problem and indeed several examples are on the market where this phenomena presents itself and causes a considerable nuisance.

The controlling area for dispensing the paint is the area of the nozzle orifice. For maximum direction of the jet a convergent i.e. conical nozzle is required and therefore the actuated part i.e. the valve member must move inwards of the valve body towards the wider part of the cone. Given these two factors the design is carefully tuned so that the annular area 32 between the conical valve member 22 and the valve body 19 on the valve stem is equal to the area of the nozzle orifice 24 when the valve is in the position shown in Figure 4. A feature of the design is therefore that the minimum overall area is achieved throughout by very careful matching of areas so that no part of the valve is bigger than it actually has to be in order to match other parts of the valve.

There are several advantageous reasons for the conical layout of the dispensing valves 6. One is that if one packs a number of nozzles together into the minimum possible area at the tip of the nozzles then they naturally tend to form a conical shape. The second reason for doing this is that it is an advantage to direct the paint to the centre of the container rather than simply to let it fall vertically downwards when it is near to the edge of the container. The third reason and possibly the most important ultimately is that the conical layout enables larger parts of the valve to be fitted on to a bigger pitch circle diameter. Thus if one needs relatively bulky springs or actuators fitted to the valve then these can be located at the opposite end of the valve to the nozzle where there is more space and where use of this space does not prejudice the ability to load a small container.

In the particular example shown the valves are of simple conical shape and they are all directed towards the intersection of the X and Y axes shown in Figure 6. One could have a variant on this where the angles of the cone are compounded such that one could if one wished promote swirl by arranging the valves in a conical pattern but aimed at some point off the centre of the container when viewed in plan.

Since all dispensing valves are present over the container it is not necessary to move either the valves or the container in order to direct a number of paint streams to the container. This represents a very considerable advantage over other machines which are currently on the market. Since the rate of discharge is related to the size of the container it is perfectly possible to scale up this design such that if the container was 1 tonne size rather than 1 litre size then the valves would be larger in diameter but the arrangement would be the same and simply on a larger scale.

In the above described system, the valves 6 can open by anchoring the stem 18 and allowing the valve body to move downwards relative to the

valve stem. Alternatively one can choose to anchor the valve body and permit the stem to move.

One of the most significant features of the above described system is that the dispensing valves do not need mechanical actuation at all. The valves are designed to be actuated by the hydraulic pressure of the paint. Thus there are very few moving parts in the valve and very little to go wrong. Since it is so simple it is very cheap to make.

A particular feature of the system described above is that the valve is very unlikely to leak when it is supposed to be closed. In most commercially available valves the pressure is still on the valve after the valve has closed and any small imperfections in the seating face will cause a leak. In the present system, however, the closing mechanism is simply one of falling pressure. In other words when the end of the dispense is reached the actuated three way valve is positioned so that paint flows back to the tank, the pressure drops in the line leading to the valve and the valve closes. Thereafter there is very little that can happen to cause the valve to leak. There is no pressure transmitted across the actuated three way valve, hence the route back to the tank has been made easy and there is a considerable sealing force generated by the spring in the dispensing valve and nothing being supplied to overcome the force of that spring. In fact with this particular design where the pressure is removed upstream of the valve when the valve is not required to operate, one has a situation where the valve is very unlikely to leak even if the valve seating became damaged a little by the odd paint particle or any other foreign body.

A further feature of the design of dispensing valve is that when closed the valve has the absolute minimum possible surface area available for paint to dry upon. Secondly as the valve closes it tries to expel the remaining drops of paint which is different to the other valves where the closing of the valves tends to splash paint on to the body of the valve. If paint is allowed to collect on the bottom of the valve it can build up and eventually form stalactites and in any case it is a nuisance since it can cause contamination. The most practical way to limit contamination is firstly to prevent the paint sticking there in the first place and then to limit the surface area such that if paint does stick there it is very small and minimal amount.

Claims

1. A liquid dispensing system comprising a circulating path (1) for the liquid to and from a reservoir (3), means (2) for pressurising the liquid to cause it to circulate around said path (1), a first valve means (4) controllable to divert the liquid from the circulating path (1) to a dispensing nozzle, characterised in that a second valve means (6) is provided past which the diverted liquid flows, said second valve means (6) being biased to a closed position to prevent the flow of diverted liquid and being openable by the hydraulic pressure of the liquid to permit the diverted liquid to pass said second valve means (6) to said nozzle (14).

2. A liquid dispensing system according to Claim 1, characterised in that said second valve means (6) comprises an outer elongated tubular body (19) having said nozzle (14) at one end.

3. A liquid dispensing system according to Claim 2, characterised in that said second valve means (6) has a conical valve member (22) which is biased into engagement with a conical seat (23) within the valve body (19) at the nozzle (14) to close the second valve means (6) and is moved longitudinally within the body (19) to open the second valve means (6).

4. A liquid dispensing system according to Claim 3, characterised in that when the second valve means (6) is fully open the annular cross-sectional area (32) between the valve member (22) and the valve body (19) is substantially equal to the cross-sectional area of the orifice (24) of the nozzle (14).

5. A liquid dispensing system according to Claim 3 or 4, characterised in that said second valve means (6) has a valve stem (18) which carries said valve member (22) at one end, a piston formation (29) is mounted on said valve stem (18) at a position intermediate its ends and is slidable within said valve body (19), said valve stem (18) has a bore (25) extending from its end remote from the valve member (22) which end constitutes a liquid inlet for diverted liquid, said bore opening into the interior space (28) of the valve body (19) at a position between the piston formation (29) and the valve member (22), whereby diverted liquid fed under pressure through said bore (25) and into the interior of said body (19) displaces the piston formation (29) against said bias and hence causes the valve member (22) to move away from said valve seat (23).

6. A multiple liquid dispensing system comprising a plurality of liquid dispensing systems according to any one of Claims 2 to 5, the plurality of said second valve means (6) being arranged in a group with the plurality of said nozzles (14) disposed so that they can all dispense liquid into the same container without having to move the container.

7. A multiple liquid dispensing system according to Claim 6, characterised in that said group of second valve means (6) is arranged in a conical formation with the nozzles (14) directed towards the apex of the cone.

8. A multiple liquid dispensing system according to Claim 7, wherein the apex of the cone lies on the central vertical axis of a container and within the container at a filling station.

9. A multiple liquid dispensing system according to any one of claims 6 to 8, wherein each of said second valve means (6) is mounted in a respective bore of a common mounting block (16).

Fig. 1.

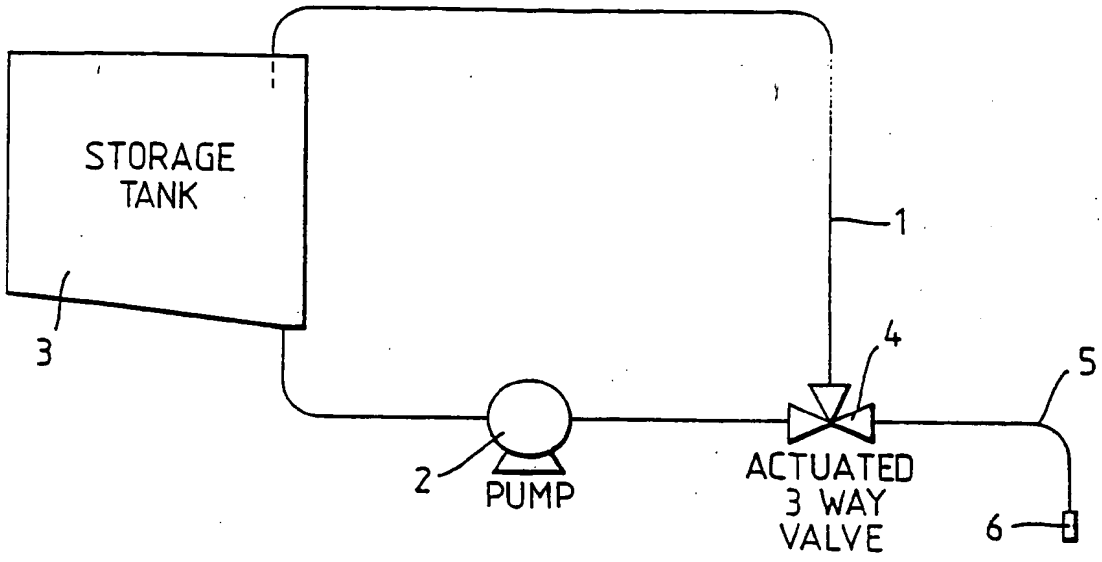


Fig. 6.

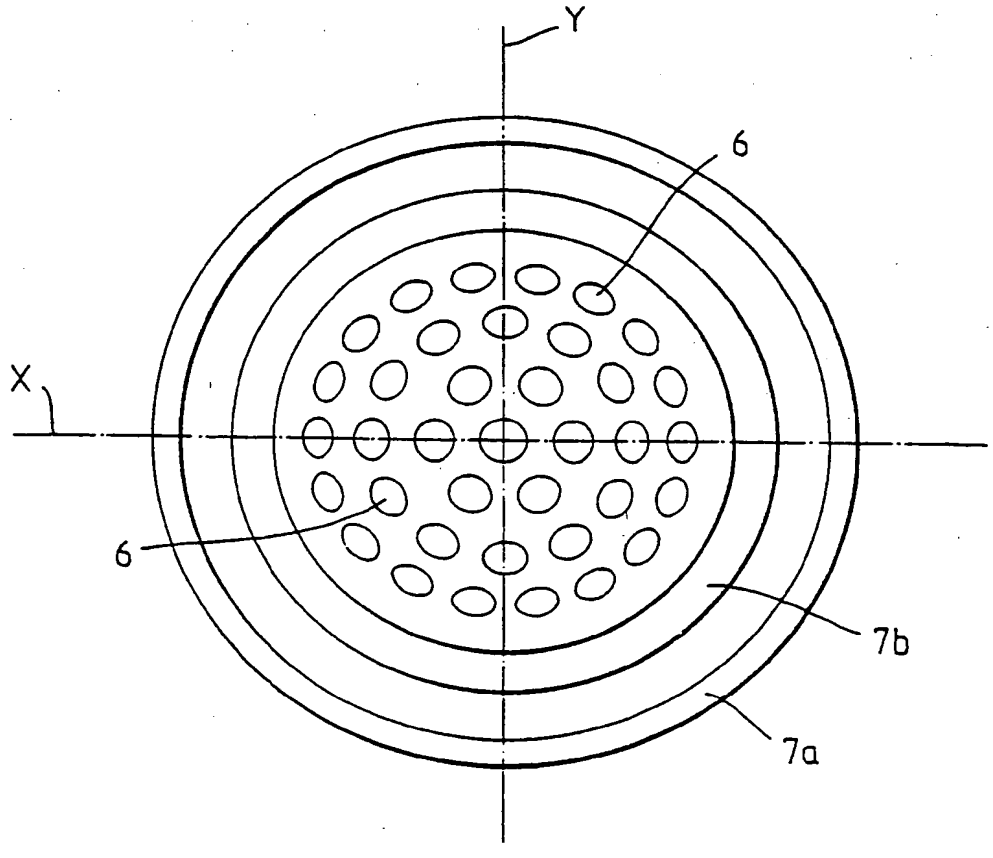


Fig. 2.

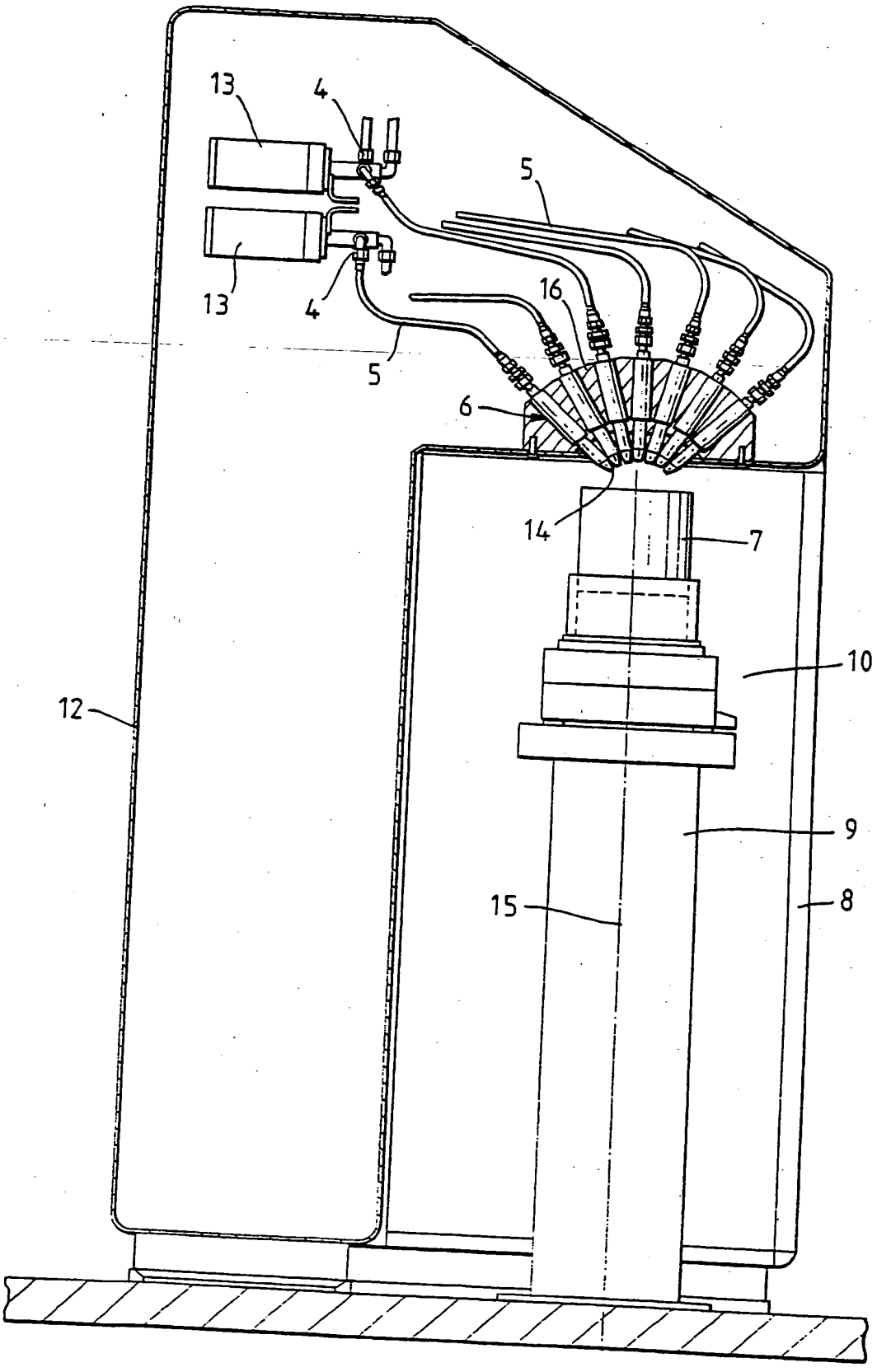


Fig. 3.

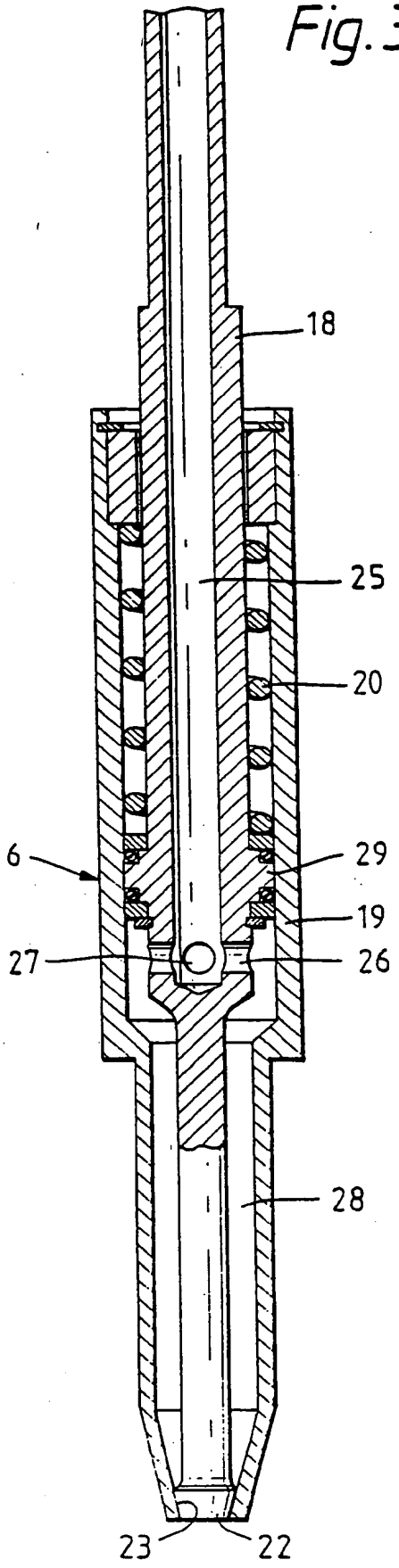


Fig. 4.

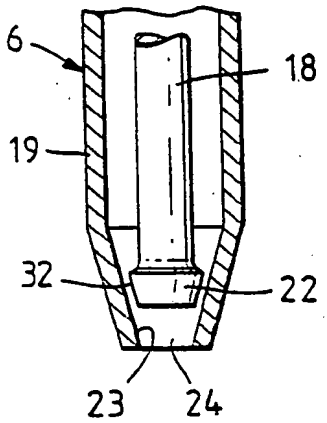
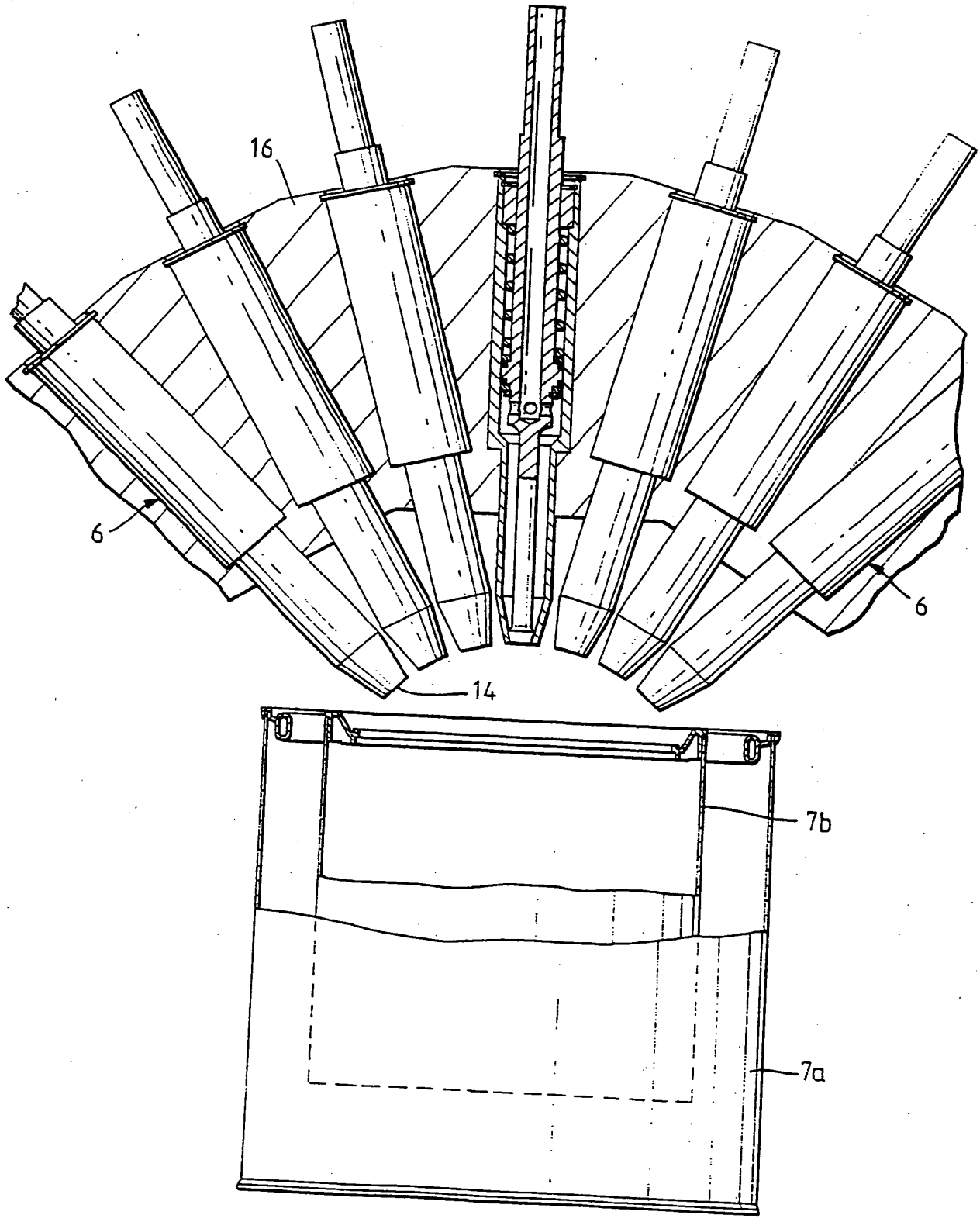


Fig. 5.



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EUROPEAN SEARCH REPORT

Application Number

EP 88 30 1400

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	EP-A-0 083 821 (J. GERRITSE) * Claims 1,4; figure 1 *	1	B 44 D 3/00 B 44 D 3/08 B 65 B 3/12
A	DE-A-2 805 942 (A. BERENTS) * Figure 1; claims 1,2 *	1	
	DE-A-1 625 250 (VEB BODENBEARBEITUNGSGERÄTE) * Figure 1; claim 1 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 44 D
B 01 F
B 05 B
B 65 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	07-06-1988	MCCONNELL C.H.

CATEGORY OF CITED DOCUMENTS

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